In This Section

- Sources and Types of Environmental Stressors
- Summary of Stressors Affecting Water Quality

Section 4

Water Quality: Environmental Stressors

Section 4, 5, 6, and 7 are closely linked, providing the foundation for the water quality concerns in the basin, identifying the priority issues based on these concerns, and finally, recommending management strategies to address these concerns. Therefore, the reader will probably want to flip back and forth between sections to track specific issues.

This section describes the important environmental stressors that impair or threaten water quality in the Oconee River basin. Section 4.1 first discusses the major sources of environmental stressors. Section 4.2 then provides a summary of individual stressor types as they relate to all sources. These include both traditional chemical stressors, such as metals or oxygen demanding waste, and less traditional stressors, such as modification of the flow regime (hydromodification) and alteration of physical habitat.

4.1 Sources and Types of Environmental Stressors

Environmental stressors are first catalogued by type of source in this section. This is the traditional programmatic approach, and it provides a match to regulatory lines of authority for permitting and management. Assessment requires an integration of stressor loads across all sources, as described in Section 4.2.

4.1.1 Point Sources and Nondischarging Waste Disposal Facilities

Point sources are defined as discharges of treated wastewater to the river and its tributaries, regulated under the National Pollutant Discharge Elimination System (NPDES). These are divided into two main types–permitted wastewater discharges, which tend to be discharged at relatively stable rates, and permitted storm water discharges, which tend to be discharged at highly irregular, intermittent rates, depending on precipitation. Nondischarging waste disposal facilities, which prevent discharge of wastewater effluent to surface waters, are also discussed in this section.

NPDES Permitted Wastewater Discharges

Table 4-1 displays the major municipal wastewater treatment plants with permitted discharges of 1 million gallons per day (MGD) or greater in the Oconee River basin. The geographic distribution of dischargers is shown in Figure 4-1. In addition, there are discharges from a variety of smaller wastewater treatment plants, including both public facilities (small public water pollution control plants, schools, marinas, etc.) and private facilities (package plants associated with non-sewered developments and mobile home parks) with less than a 1-MGD flow. These minor discharges might have the potential to cause localized stream impacts, but they are relatively insignificant from a basin perspective.

Table 4-1. Major Municipal Wastewater Treatment Plant Discharges with Permitted Monthly Average Flow Greater than 1 MGD in the Oconee River Basin

NPDES Permit #	Facility Name	Authority	County	Receiving Stream	Permitted Monthly Average Flow (MGD)
Oconee River Above Lake Sinclair Dam (HUC 03070101)					
GA0021725	Athens, North	Athens	Clarke	North Oconee River	10.72
GA0021733	Athens, Middle	Athens	Clarke	Middle Oconee River	6.00
GA0034584	Athens, Cedar Creek	Athens	Clarke	Cedar Creek	2.00
Oconee River Below Lake Sinclair Dam (HUC 03070102)					
GA0030775	Milledgeville WPCP	Milledgeville	Baldwin	Oconee River	7.00
GA0032051	Sandersville WPCP	Sandersville	Washington	Tanyard Branch	1.70
GA0025569	Dublin WPCP	Dublin	Laurens	Oconee	4.00

The EPD NPDES permit program regulates municipal and industrial waste discharges, monitors compliance with limitations, and takes appropriate enforcement action for violations. For point source discharges, the permit establishes specific effluent limitations and specifies compliance schedules that must be met by the discharger. Effluent limitations are designed to achieve water quality standards in the receiving water and are reevaluated periodically (at least every 5 years).

Municipal Wastewater Discharges

Municipal wastewater treatment plants are among the most significant point sources regulated under the NPDES program in the Oconee River basin, accounting for the majority of the total point source effluent flow (exclusive of cooling water). These plants collect, treat, and release large volumes of treated wastewater. Pollutants associated with treated wastewater include pathogens, nutrients, oxygen-demanding waste, metals, and chlorine residuals. Over the past several decades, Georgia has invested more than $15 million in construction and upgrade of municipal water pollution control plants in the Oconee River basin; a summary of these investments is provided in Appendix C. These upgrades have resulted in significant reductions in pollutant loading and consequent improvements in water quality below wastewater treatment plant outfalls. As of the 1996-1997 water quality assessment, only two segments (21 miles) of river/streams were identified in which municipal discharges contributed to not fully supporting designated uses, all of which are being addressed through the NPDES permitting process.

Most urban wastewater treatment plants also receive industrial process and nonprocess wastewater, which can contain a variety of conventional and toxic pollutants. The control of industrial pollutants in municipal wastewater is addressed through

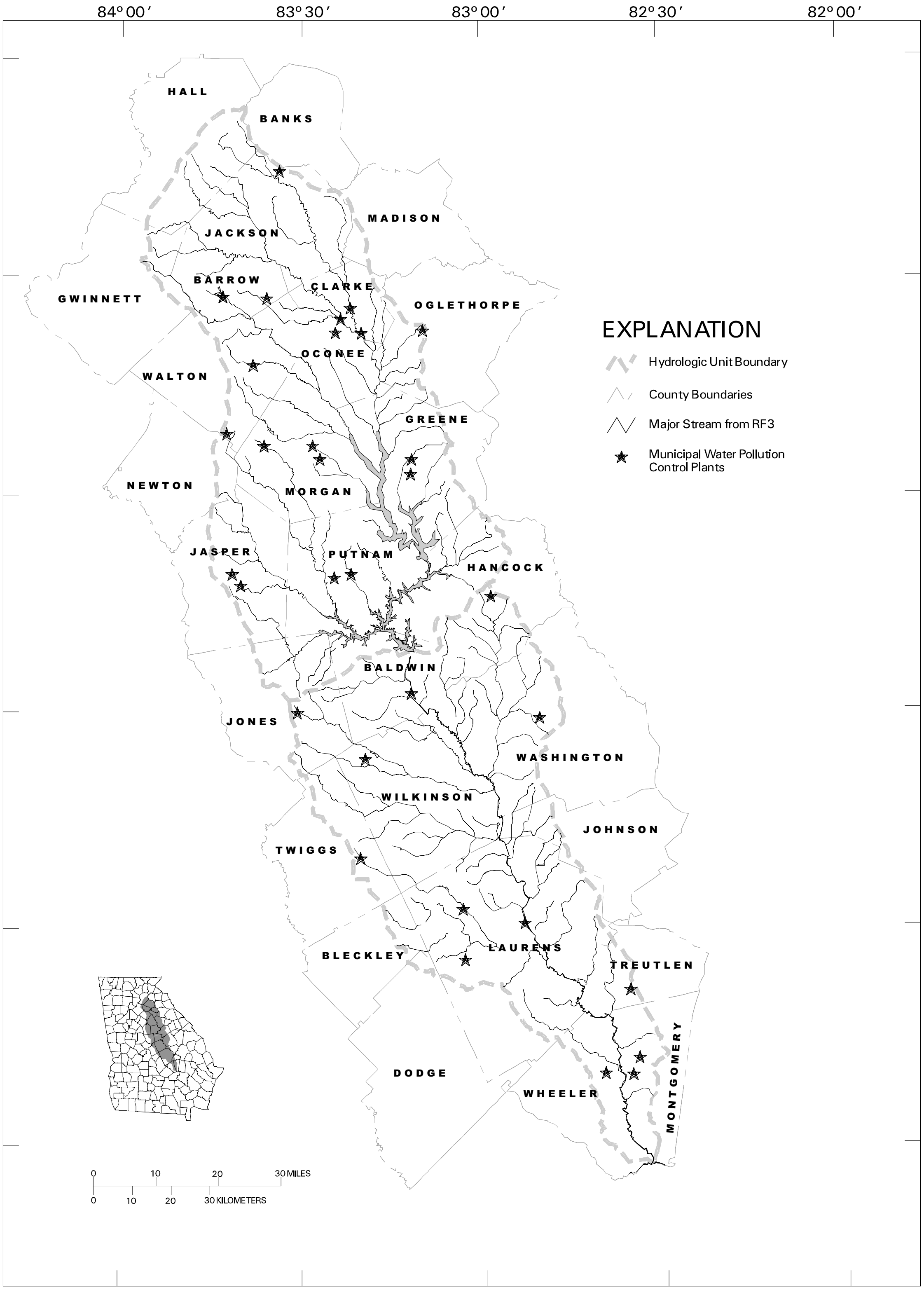

Figure 4-1. Location of Municipal Wastewater-Treatment Plants in the Oconee River Basin

pretreatment programs. The major publicly owned wastewater treatment plants in this basin have developed and implemented approved local industrial pretreatment programs. Through these programs, the wastewater treatment plants are required to establish effluent limitations for their significant industrial dischargers (those which discharge in excess of 25,000 gallons per day of process wastewater or are regulated by a Federal Categorical Standard) and to monitor the industrial user's compliance with those limits. The treatment plants are able to control the discharge of organics and metals into their sewerage system through the controls placed on their industrial users.

Industrial Wastewater Discharges

Industrial and federal wastewater discharges are also significant point sources regulated under the NPDES program. There are a total of 73 permitted municipal, state, federal, private, and industrial wastewater and process water discharges in the Oconee River basin, as summarized in Table 4-2. The complete permit list is summarized in Appendix D.

Table 4-2. Summary of NPDES Permits in the Oconee River Basin

HUC	Major Municipal Facilities	Major Industrial and Federal Facilities	Minor Public Facilities	Minor Private and Industrial Facilities	Total
03070101	3	2	18	17	40
03070102	3	2	10	18	33
Total	*6*	*4*	*28*	*35*	*73*

The flow rates for industrial discharges in the Oconee basin are relatively low. However, the nature of industrial discharges varies widely compared to discharges from municipal plants, effluent flow is not usually a good measure of the significance of an industrial discharge. Industrial discharges can consist of organic, heavy oxygen-demanding waste loads from facilities such as pulp and paper mills; large quantities of noncontact cooling water from facilities such as power plants; pit pumpout and surface runoff from mining and quarrying operations, where the principal source of pollutants is the land-disturbing activity rather than the addition of any chemicals or organic material; or complex mixtures of organic and inorganic pollutants from chemical manufacturing, textile processing, metal finishing, etc. Pathogens and chlorine residuals are rarely of concern with industrial discharges, but other conventional and toxic pollutants must be addressed on a case-by-case basis through the NPDES permitting process. Georgia's 1996-1997 water quality assessment report identified one segment (3 miles) of river/stream in the basin where permitted industrial discharges contributed to a failure to support designated uses; this is being addressed through the NPDES permitting process. In addition, one industry has contributed to exceedances of the temperature criterion in Lake Sinclair; this also is being addressed through the NPDES permitting process. Table 4-3 lists the major industrial and federal wastewater treatment plants WITH discharges into the Oconee River basin in Georgia.

There are also 19 minor industrial discharges which may have the potential to cause localized stream impacts, but are relatively insignificant from a basin perspective. The locations of permitted point source discharges of treated wastewater in the Oconee River basin are shown in Figures 4-2 and 4-3.

Combined Sewer Overflows

Combined sewers are sewers that carry both storm water runoff and sanitary sewage in the same pipe. Most of these combined sewers were built at the turn of the century and were present in most large cities. At that time both sewage and storm water runoff were

Table 4-3. Major Industrial and Federal Wastewater Treatment Facilities in the Oconee River Basin

NPDES Permit #	Facility Name	Description	Flow and Load	Receiving Stream
HUC 03070101: Oconee River Above Lake Sinclair Dam				
GA0002712	TEXFI Industries	Textile finishing	Average 0.123 MGD BOD-5: 93 lb/day TSS: 250 lb/day Chromium: 1.4 lb/day	Middle Oconee River
GA0026051	Georgia Power, Plant Branch	Power generation	Average 1180 MGD No significant pollutant loads.	Lake Sinclair
HUC 03070102: Oconee Below Lake Sinclair Dam				
GA0003670	Forstmann & Company	Textile finishing	Average 2.30 MGD BOD-5: 750 lb/day TSS: 1870 lb/day Chromium: 7.4 lb/day	Oconee River
GA0032620	Southeast Paper Manufacturing	Paper manufacturing	Average 14.3 MGD BOD-5: 4500 lb/day TSS: 7130 lb/day	Oconee River

piped from the buildings and streets to the small streams that originated in the heart of the city. When these streams were enclosed in pipes, they became today's combined sewer systems. As the cities grew, their combined sewer systems expanded. Often new combined sewers were laid to move the untreated wastewater discharge to the outskirts of the town or to the nearest waterbody.

In later years wastewater treatment facilities were built and smaller sanitary sewers were constructed to carry the sewage (dry weather flows) from the termination of the combined sewers to these facilities for treatment. However, during wet weather, when significant storm water is carried in the combined system, the sanitary sewer capacity is exceeded and a combined sewer overflow (CSO) occurs. The surface discharge is a mixture of storm water and sanitary waste. Uncontrolled CSOs thus discharge raw diluted sewage and can introduce elevated concentrations of bacteria, BOD, and solids into a receiving water body. In some cases, CSOs discharge into relatively small creeks.

CSOs are considered a point source of pollution and are subject to the requirements of the Clean Water Act. Although CSOs are not required to meet secondary treatment effluent limits, sufficient controls are required to protect water quality standards for the designated use of the receiving stream. In its 1990 session, the Georgia Legislature passed a CSO law requiring all Georgia cities to eliminate or treat CSOs.

There are no CSOs in the Oconee River basin since no municipalities in the basin have combined sewer systems.

NPDES Permitted Storm Water Discharges

Urban storm water runoff in the Oconee basin has been identified as a major source of stressors from pollutants such as oxygen-demanding waste (BOD) and fecal coliform bacteria. Storm water can flow directly to streams as a diffuse, nonpoint process or can be collected and discharged through a storm sewer system. Storm sewers are now subject to NPDES permitting and are discussed in this section. Contributions from nonpoint storm water is discussed in Section 4.1.2.2.

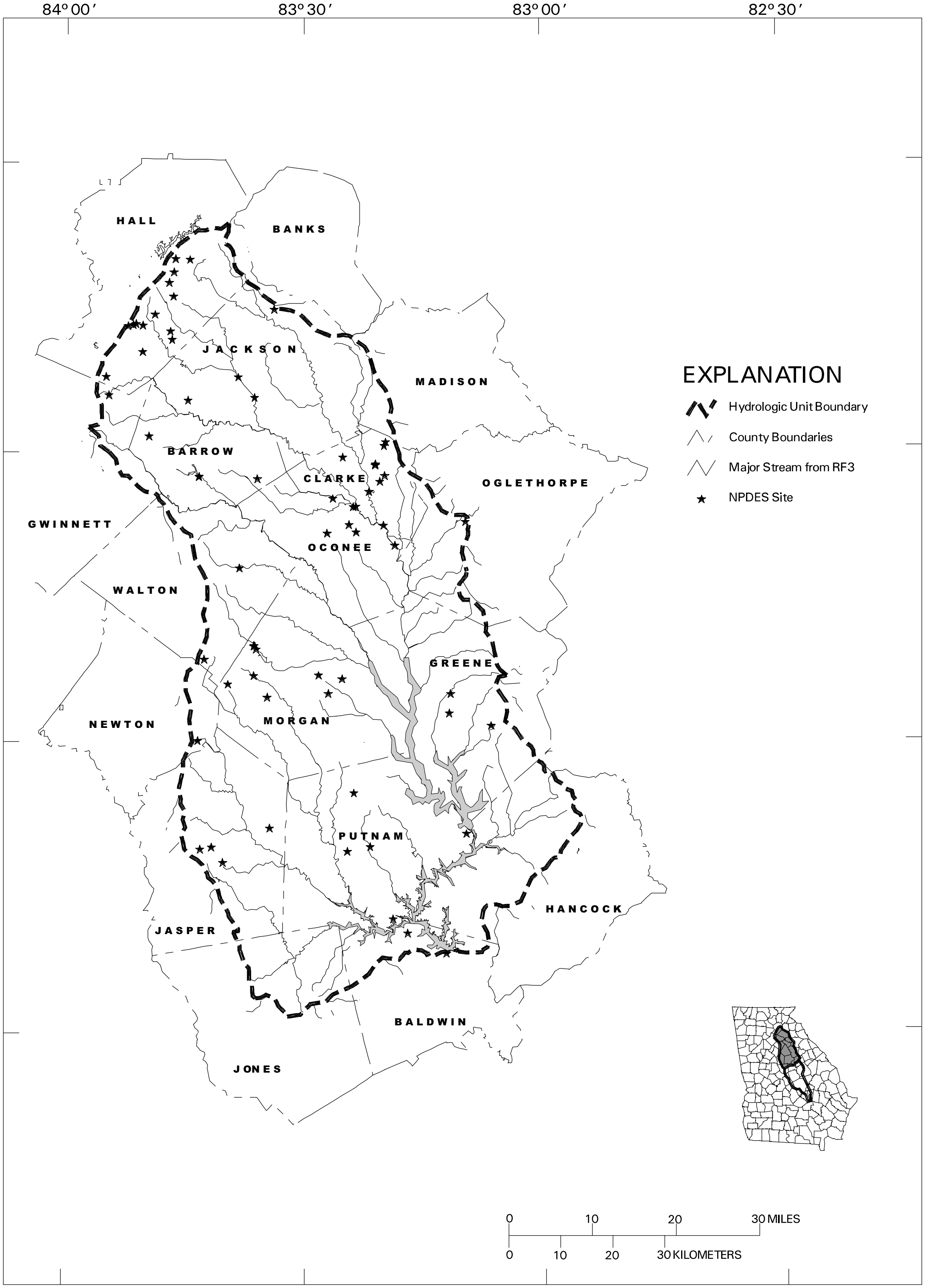

Figure 4-2. NPDES Sites Permitted by GAEPD, Upper Oconee River Basin, HUC 03070101

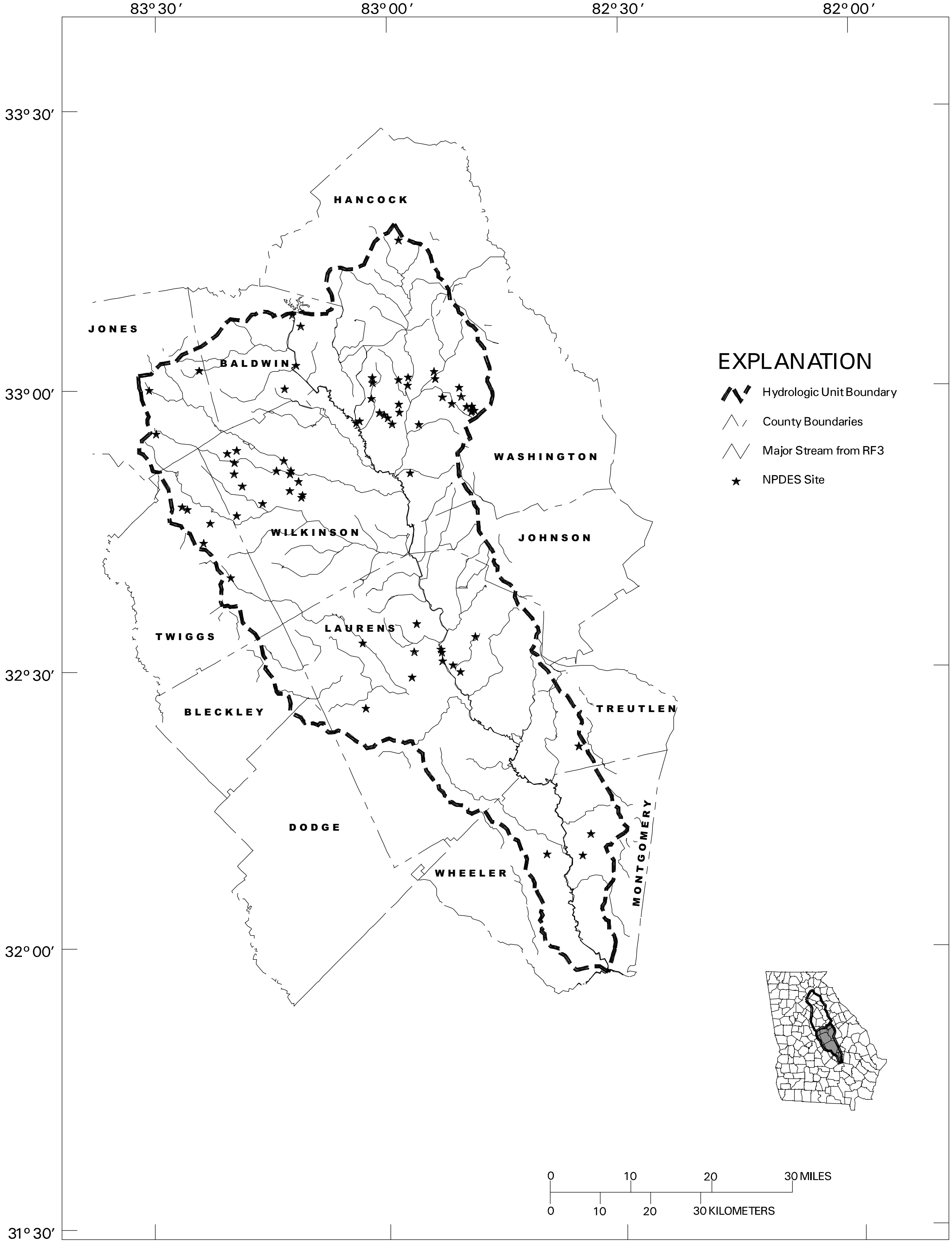

Figure 4-3. NPDES Sites Permitted by GAEPD, Lower Oconee River Basin, HUC 03070102

Pollutants typically found in urban storm water runoff include pathogens (such as bacteria and viruses from human and animal waste), heavy metals, debris, oil and grease, petroleum hydrocarbons, and a variety of compounds toxic to aquatic life. In addition, the runoff often contains sediment, excess organic material, fertilizers (particularly nitrogen and phosphorus compounds), herbicides, and pesticides, which can upset the natural balance of aquatic life in lakes and streams. Storm water runoff can also increase the temperature of a receiving stream during warm weather, which can have an adverse impact on aquatic life. All of these pollutants, and many others, influence the quality of storm water runoff. There are also many potential problems related to the quantity of urban runoff, which can contribute to flooding and erosion in the immediate drainage area and downstream.

Municipal Storm Water Discharges

In accordance with Federal "Phase I" storm water regulations, the state of Georgia has issued individual areawide NPDES municipal separate storm sewer system (MS4) permits to 58 cities and counties in municipal areas with populations greater than 100,000 persons. Permits in the Oconee basin are shown in Table 4-4.

Table 4-4. Permitted Municipal Separate Storm Sewer Systems, Oconee River Basin

Permit #	GAS000139	GAS000118
Permittee	Dacula	Gwinett County
Contact	Mike Moon, Mayor	David Chastant, DOT
Address	P.O. Box 400	75 Langley Drive
City	Dacula	Lawrenceville
ZIP	30211	30245
County	Gwinett	Gwinett
Type	Large/Gwinett Coapp	Large/Lead Coapp
Issued	6/15/94	6/15/94
Expires	6/14/99	6/14/99
HUC	03070101	03070101

Industrial Storm Water Discharges

Industrial sites often have their own storm water conveyance systems. The volume and quality of storm water discharges associated with industrial activity is dependent on a number of factors, such as the industrial activities occurring at the facility, the nature of the precipitation, and the degree of surface imperviousness. These discharges are of intermittent duration with short-term pollutant loadings that can be high enough to have shock loading effects on the receiving waters. The types of pollutants from industrial facilities are generally similar to those found in storm water discharges from commercial and residential sites; however, industrial facilities have a significant potential for discharging at higher pollutant concentrations and may include specific types of pollutants associated with a given industrial activity.

EPD has issued one general permit regulating storm water discharges for 10 of 11 federally regulated industrial subcategories. The 11th subcategory, construction activities, will be covered under a separate general permit. The general permit for industrial activities requires the submission of a Notice of Intent (NOI) for coverage under the general permit; the preparation and implementation of a storm water pollution prevention plan; and, in some cases, the monitoring of storm water discharges from the facility. As with the municipal storm water permits, implementation of site-specific best management practices is the preferred method for controlling storm water runoff. As of March 1998, 201 NOIs had been filed for the Oconee basin. The distribution of NOIs by HUC is as follows:

HUC 03070101 (Upper Oconee)	151
HUC 03070102 (Lower Oconee)	51

Non-discharging Waste Disposal Facilities

Land Application Systems (LASs)

In addition to permits for point source discharges, EPD has developed and implemented a permit system for land application systems (LASs). LASs for final disposal of treated wastewaters have been encouraged in Georgia and are designed to eliminate surface discharges of effluent to waterbodies. LASs are used as an alternative to advanced levels of treatment or as the only alternative in some environmentally sensitive areas.

When properly operated, a LAS should not be a source of stressors to surface waters. The locations of LASs are, however, worth noting because of the (small) possibility that a LAS could malfunction and become a source of stressor loading.

A total of 128 municipal and 35 industrial permits for land application systems were in effect in Georgia in 1998. Municipal and other major wastewater land application systems (permitted flow greater than 0.01 MGD) within the Oconee Basin are listed in Table 4-5. The locations of all LASs within the basin are shown in Figures 4-4 through 4-5.

Table 4-5. Wastewater Land Application Systems in the Oconee River Basin

Operator	Location	Permit No.	Permitted Flow (MGD)
HUC 03070101 (Oconee River above Lake Sinclair Dam)			
Braselton LAS	Jackson	GA02-175	0.105
Jefferson LAS	Jackson	GA02-230	0.287
Wayne Poultry Company	Jackson	GA01-546	0.700
Mott's Valley Fresh, Inc.	Jackson	GA01-477	0.080
Winder LAS	Barrow	GA02-014	1.650
Barrow Co. Board of Comm	Barrow	GA02-271	0.500
Harrison Poultry	Barrow	GA01-532	0.700
Family Live Enrichment Center	Oconee	GA03-928	0.012
Linger Longer LAS	Greene	GA03-897	0.075
Great Waters LAS	Putnam	GA02-072	0.070
HUC 03070102 (Oconee River below Lake Sinclair Dam)			
East Dublin LAS	Laurens	GA02-270	0.312
Campbells Frest	Laurens	GA01-389	0.100

Landfills

Permitted landfills are required to contain and treat any leachate or contaminated runoff prior to discharge to any surface water. The permitting process encourages either direct connection to a publicly owned treatment works (although vehicular transportation

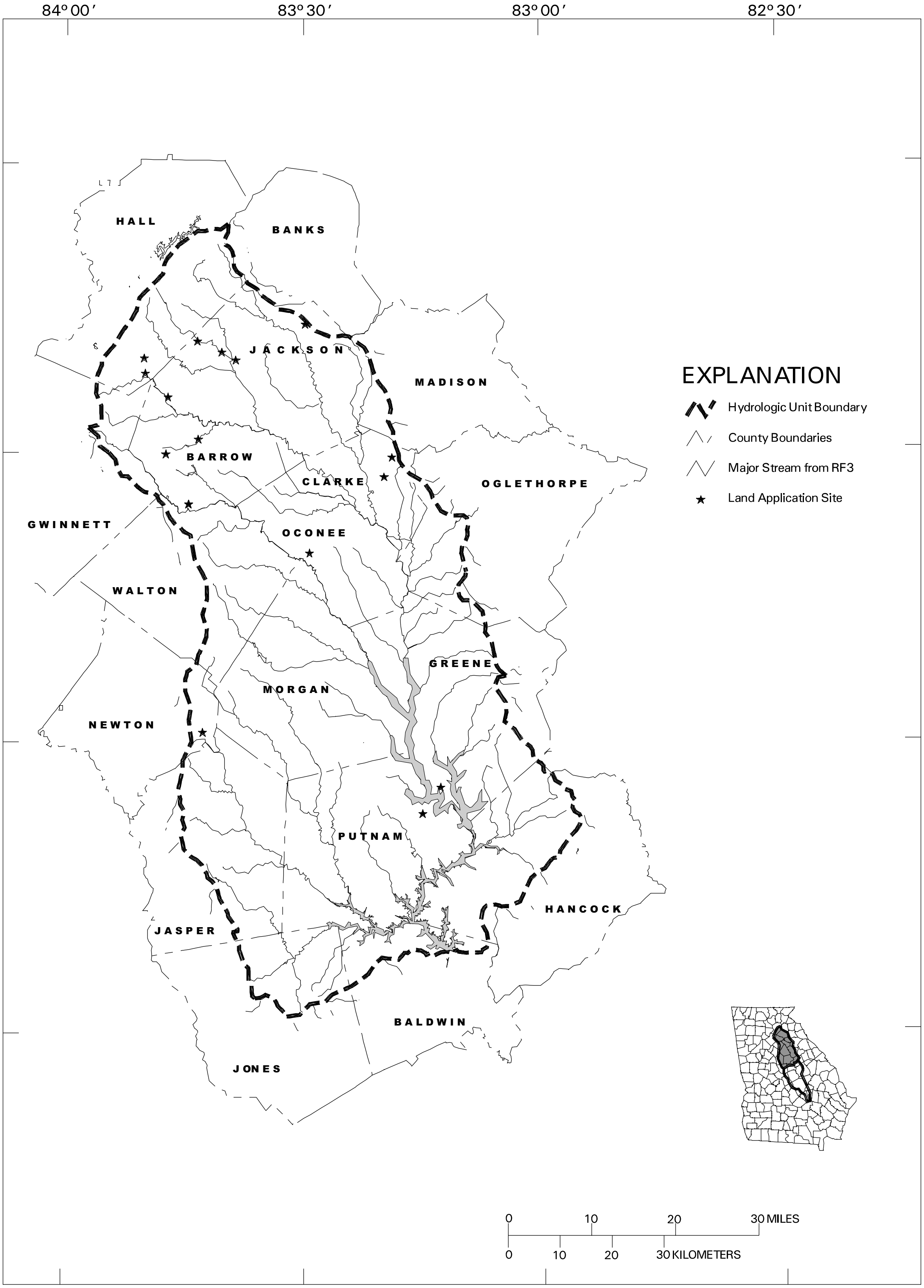

Figure 4-4. Land Application Systems, Upper Oconee River Basin, HUC 03070101

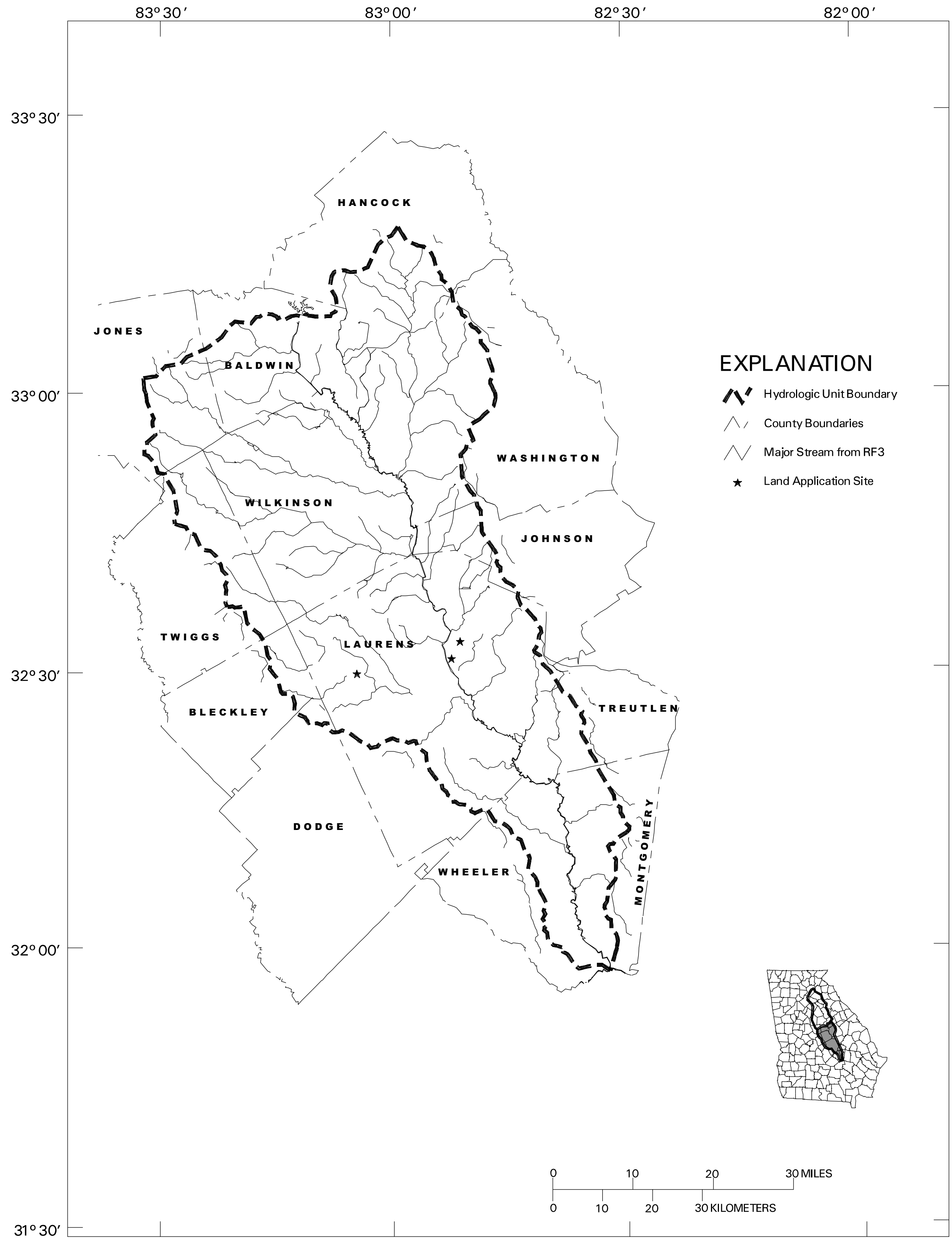

Figure 4-5. Land Application Systems, Lower Oconee River Basin, HUC 03070102

is allowed in certain cases) or treatment and recirculation on site to achieve a no-discharge system. Direct discharge in compliance with NPDES requirements is allowed but is not currently practiced at any landfills in Georgia. Ground water contaminated by landfill leachate from older, unlined landfills represents a potential threat to waters of the state. Ground water and surface water monitoring and corrective action requirements are in place for all landfills operated after 1988 to identify and remediate potential threats. The provisions of the Hazardous Sites Response Act address threats posed by older landfills as releases of hazardous constituents are identified. All new municipal solid waste landfills are required to be lined and to have a leachate collection system installed.

EPD's Land Protection Branch is responsible for permitting and compliance of municipal and industrial Subtitle D landfills. The location of permitted landfills within the basin is shown in Table 4-6 and Figures 4-6 through 4-7.

4.1.2 Nonpoint Sources

The pollution impact on Georgia's streams has radically shifted over the last two decades. Streams are no longer dominated by untreated or partially treated sewage discharges which resulted in little or no oxygen and little or no aquatic life. The sewage is now treated, oxygen levels have recovered, and healthy fisheries have followed. Industrial discharges have also been placed under strict regulation. However, other sources of pollution are still affecting Georgia's streams. These sources are referred to as *nonpoint sources*. Nonpoint sources are diffuse in nature. They can generally be defined as the pollution caused by rainfall or snowmelt moving over and through the ground. As water moves over or through the soil, it picks up and carries away natural pollutants and pollutants resulting from human activities, finally depositing them in lakes, rivers, wetlands, coastal waters, or ground water. Habitat alteration (e.g., removal of riparian vegetation) and hydrological modification (e.g., channelization, bridge construction) can cause adverse effects on the biological integrity of surface waters and are also treated as nonpoint sources of pollution. Nonpoint pollutant loading comprises a wide variety of sources not subject to point source control through NPDES permits. The most significant nonpoint sources are those associated with precipitation, washoff, and erosion, which can move pollutants from the land surface to water bodies. Both rural and urban land uses can contribute significant amounts of nonpoint pollution. A review of 1996-1997 water quality assessment results for the Oconee basin indicates that urban runoff and rural nonpoint sources contribute significantly to lack of full support for designated uses. The major categories of stressors for nonpoint sources are discussed below.

Nonpoint Sources from Agriculture

Agricultural operations can contribute stressors to water bodies in a variety of ways. Tillage and other soil-disturbing activities can promote erosion and loading of sediment to water bodies unless controlled by management practices. Nutrients contained in fertilizers, animal wastes, or natural soils may be transported from agricultural land to streams in either sediment-attached or dissolved forms. Loading of pesticides and pathogens is also of concern for various agricultural operations.

Sediment and Nutrients

Sediment is the most common pollutant resulting from agricultural operations. It consists mainly of mineral fragments resulting from the erosion of soils, but it can also include crop debris and animal wastes. Excess sediment loads can damage aquatic habitat by smothering and shading food organisms, altering natural substrate, and destroying spawning areas. Runoff with elevated sediment concentrations can also scour

Table 4-6. Permitted Landfills in the Oconee River Basin

Permit Number	Name	County	Type
005-001D(L)	Burnett Lake Laurel Road	Baldwin	Landfill
104-007D(SL)	US 441 N PH2	Morgan	Sanitary Landfill
108-002D(SL)	Mayne Mill Rd.	Oconee	Sanitary Landfill
069-007D(SL)	US 129 landfill	Hall	Sanitary Landfill
069-008D(SL)	Allen Creek PH - A	Hall	Sanitary Landfill
117-004D(SL)	Martin Mill Rd. PH1	Putnam	Sanitary Landfill
108-007D(SL)	US 441 CR 109	Oconee	Sanitary Landfill
104-006D(SL)	US 441 N PH1	Morgan	Sanitary Landfill
007-016D(SL)	Finch Road PH2 & PH3	Barrow	Sanitary Landfill
007-018D(SL)	Speedway SR 324 Site 1	Barrow	Sanitary Landfill
007-020D(SL)	Republic Waste - Oak Grove MSW	Barrow	Sanitary Landfill
029-002D(SL)	Athens-Winterville	Clarke	Sanitary Landfill
029-004D(SL)	Dunlap Rd. PH1	Clarke	Sanitary Landfill
029-009D(L)	Coggins - Trade St.	Clarke	Landfill
029-012D(SL)	Dunlap Rd. PH2 3 &4	Clarke	Sanitary Landfill
066-007D(SL)	US 278 & 77N PH1	Greene	Sanitary Landfill
066-008D(SL)	US 278 & 77N PH2	Greene	Sanitary Landfill
067-005D(L)	City of Dacula	Gwinnett	Landfill
078-009D(SL)	Prison Farm PH2	Jackson	Sanitary Landfill
117-007D(SL)	Putnam County - CR 29	Putnam	Sanitary Landfill
069-014D(C&D)	Reliable Tire Service	Hall	Construction & Demolition
069-015D(MSWL)	Candler Rd. Hwy. 60	Hall	Municipal Solid Waste
070-002D(SL)	Sparta - Fairmount/Stockade Rd	Hancock	Sanitary Landfill
079-004D(SL)	SR 212 - Monticello	Jasper	Sanitary Landfill
104-002D(SL)	Lower Apalachee Rd.	Morgan	Sanitary Landfill
005-017D(SL)	Union Hill Church Road PH3	Baldwin	Sanitary Landfill
087-008D(SL)	Bethsaida Church Rd.	Laurens	Sanitary Landfill
087-015D(SL)	Old Macon Rd.	Laurens	Sanitary Landfill
103-001D(SL)	US 221 Ailey PH1	Montgomery	Sanitary Landfill
087-009D(SL)	East Dublin - Nathaniel Dr. Ro	Laurens	Sanitary Landfill
005-005D(SL)	D&C Refuse - Woodmine	Baldwin	Sanitary Landfill
005-002D(SL)	City of Milledgeville	Baldwin	Sanitary Landfill
005-016D(SL)	Union Hill Church Road PH2	Baldwin	Sanitary Landfill
005-015D(L)	Central State Hospital - Freem	Baldwin	Landfill
005-012D(SL)	Milledgeville - English Stouff	Baldwin	Sanitary Landfill
005-004D(SL)	Central State Hospital	Baldwin	Sanitary Landfill
143-005D(SL)	Old McCallum Pond Rd.	Twiggs	Sanitary Landfill
143-008D(SL)	US 80	Twiggs	Sanitary Landfill
150-001D(SL)	SR 68	Washington	Sanitary Landfill
150-006D(SL)	Kaolin Rd. S PH1	Washington	Sanitary Landfill
150-009D(SL)	Kaolin Rd. S No. 2	Washington	Sanitary Landfill
150-010D(MSWL)	Kaolin Rd. S PH3	Washington	Municipal Solid Waste
153-005D(SL)	Treutlen & Wheeler Cos. SR 46	Wheeler	Sanitary Landfill
158-010D(SL)	SR 57 Public Works Camp	Wilkinson	Sanitary Landfill

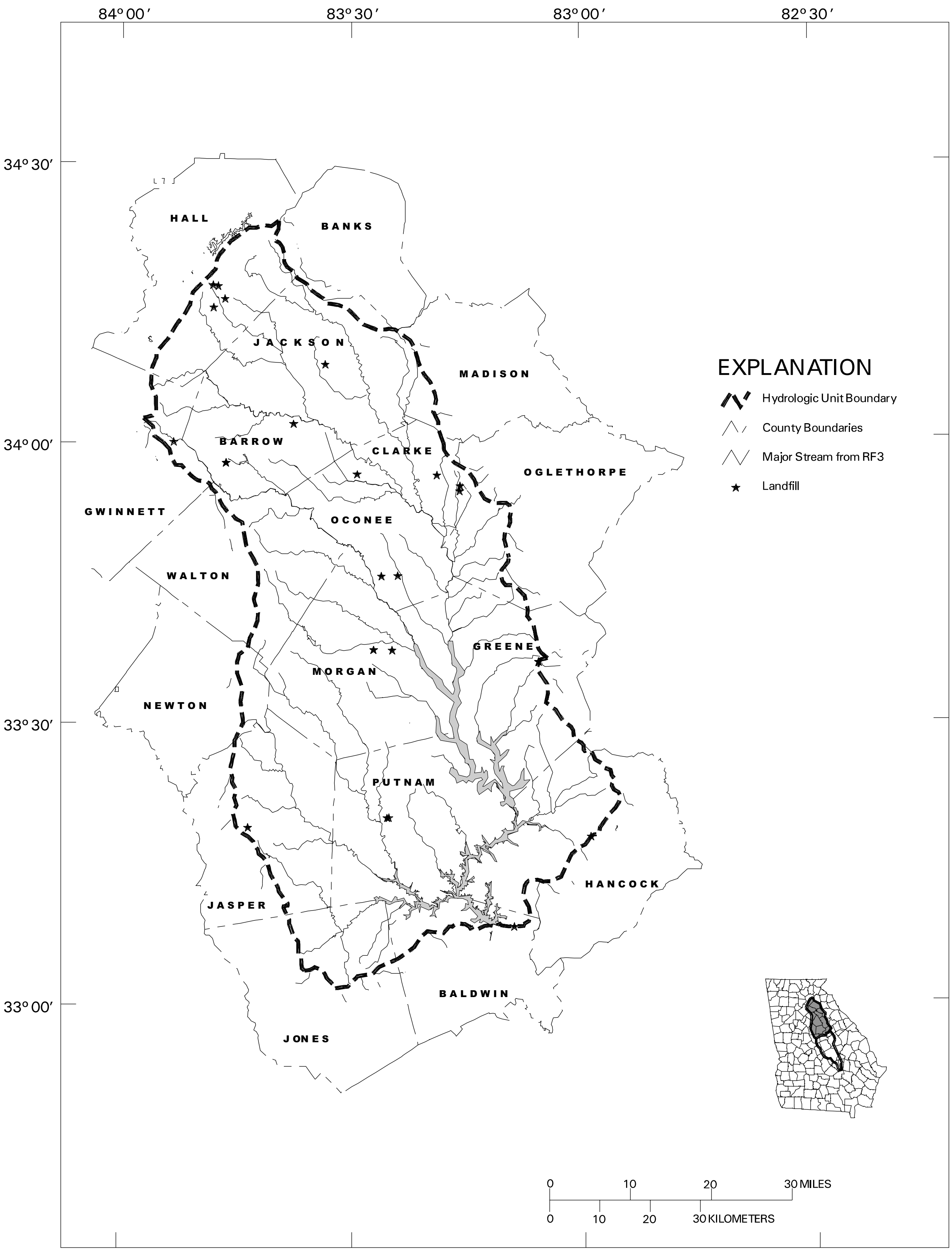

Figure 4-6. Landfills, Upper Oconee River Basin, HUC 03070101

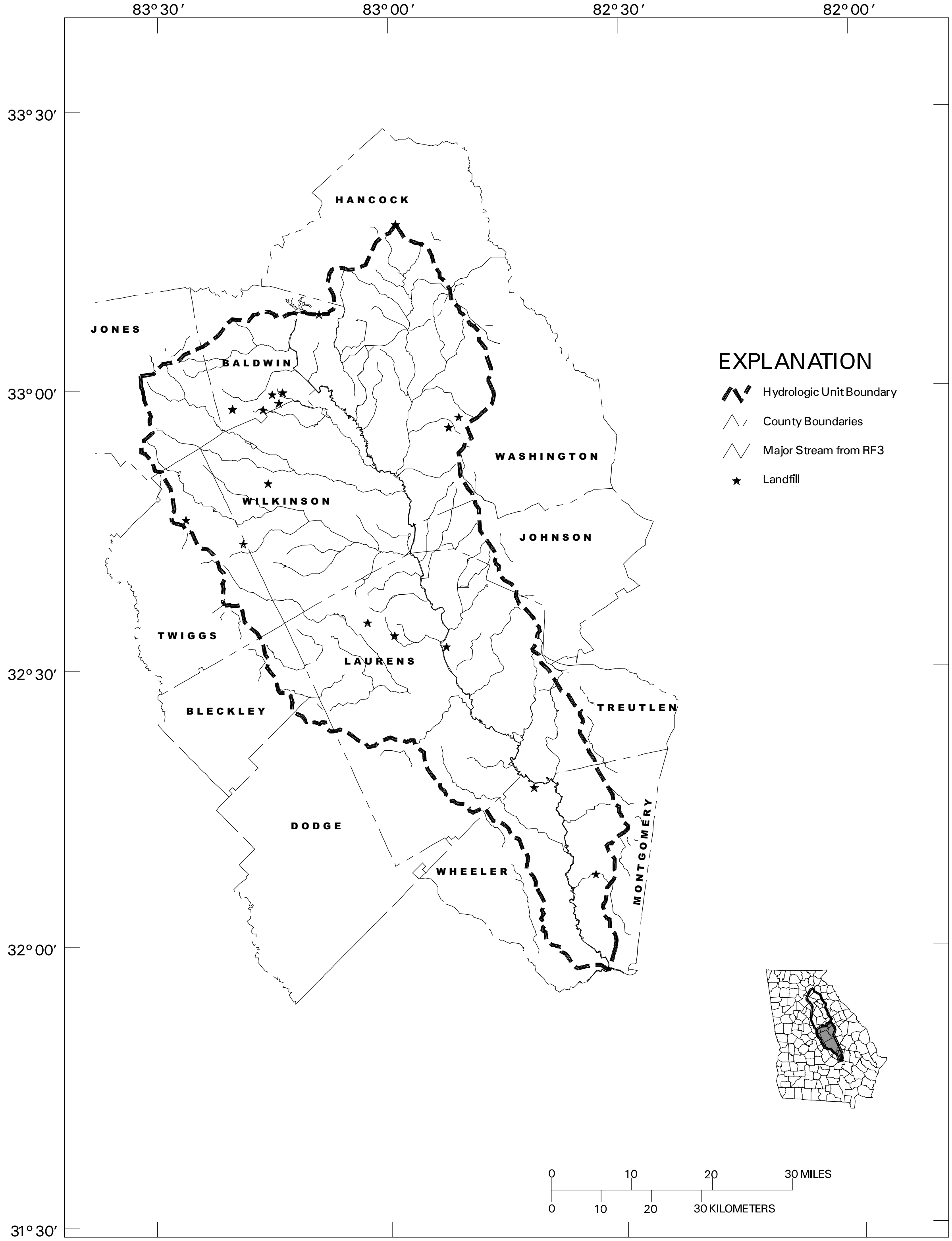

Figure 4-7. Landfills, Lower Oconee River Basin, HUC 03070102

aquatic habitat, causing significant impacts on the biological community. Excess sediment can also increase water treatment costs, interfere with recreational uses of water bodies, create navigation problems, and increase flooding damage. In addition, a high percentage of nutrients lost from agricultural lands, particularly phosphorus, is transported attached to sediment. Many organic chemicals used as pesticides or herbicides are also transported predominantly attached to sediment.

Agriculture can be a significant source of nutrients, which can lead to excess or nuisance growth of aquatic plants and depletion of dissolved oxygen. The nutrients of most concern from agricultural land uses are nitrogen (N) and phosphorus (P), which may come from commercial fertilizer or land application of animal wastes. Both nutrients assume a variety of chemical forms, including soluble ionic forms (nitrate and phosphate) and less-soluble organic forms. Less soluble forms tend to travel with sediment, whereas more soluble forms move with water. Nitrate-nitrogen is very weakly adsorbed by soil and sediment and is therefore transported entirely in water. Because of the mobility of nitrate-nitrogen, the major route of nitrate loss is to streams by interflow or to ground water in deep seepage.

Phosphorus transport is a complex process that involves different components of phosphorus. Soil and sediment contain a pool of adsorbed phosphorus which tends to be in equilibrium with the phosphorus in solution (phosphate) as water flows over the soil surface. The concentrations established in solution are determined by soil properties and fertility status. Adsorbed phosphorus attached to soil particles suspended in runoff also equilibrates with the phosphorus in solution.

In 1993, the Soil Conservation Service (SCS, now NRCS) completed a study to identify hydrologic units in Georgia with high potential for nonpoint source pollution problems resulting from agricultural land uses (SCS, 1993). This study concluded that there is not a major statewide agricultural pollution problem in Georgia. However, the assessment shows that some watersheds have sufficient agricultural loadings to potentially impair their designated uses, based on estimates of transported sediments, nutrients, and animal waste from agricultural lands (Table 4-7).

Table 4-7. Estimated Loads from Agricultural Lands by County (SCS, 1993)

County	Percent of Area in Basin	Acres with Nutrient Application	Sediment (tons)	Sediment (ppm)	Nitrogen (tons)	Nitrogen (ppm)	Phosphorus (tons)	Phosphorus (ppm)
Baldwin	100	23,104	20,698	29.5	63	0.10	25	0.038
Barrow	100	27,140	26,648	31.1	424	0.55	65	0.085
Bleckley	17	50,650	45,873	28.0	147	0.12	51	0.041
Clarke	96	8,965	16,070	55.4	121	0.48	31	0.123
Dodge	1	66,898	44,284	17.6	133	0.08	50	0.031
Greene	77	34,138	5,840	6.0	62	0.06	20	0.021
Gwinnett	14	16,491	2,761	5.9	75	0.16	18	0.038
Hall	37	44,459	33,924	26.8	453	0.36	87	0.069
Hancock	69	19,267	9,754	16.1	30	0.06	12	0.022
Jackson	93	57,347	37,374	21.3	423	0.26	101	0.062
Jasper	64	35,960	13,739	12.9	99	0.10	39	0.038
Johnson	15	52,411	52,700	26.9	202	0.16	64	0.051
Jones	56	24,772	31,043	43.5	109	0.16	39	0.056
Laurens	81	100,335	100,069	26.8	296	0.12	108	0.044

County	Percent of Area in Basin	Acres with Nutrient Application	Sediment (tons)	Sediment (ppm)	Nitrogen (tons)	Nitrogen (ppm)	Phosphorus (tons)	Phosphorus (ppm)
Madison	5	54,858	74,106	43.5	481	0.31	72	0.046
Montgomery	42	36,693	32,710	25.4	92	0.10	36	0.040
Morgan	100	63,132	56,669	29.3	272	0.15	93	0.052
Newton	11	40,140	51,916	44.0	153	0.14	60	0.053
Oconee	100	27,359	30,067	32.7	396	0.51	86	0.112
Oglethorpe	17	41,384	31,518	24.6	315	0.27	84	0.072
Putnam	100	37,926	33,302	30.9	153	0.14	48	0.045
Treutlen	35	19,053	16,644	21.6	46	0.10	18	0.039
Twiggs	36	17,745	17,509	29.4	47	0.11	18	0.043
Walton	50	46,626	49,674	31.9	198	0.15	69	0.053
Washington	42	90,978	94,776	35.3	265	0.12	101	0.046
Wheeler	45	34,600	40,088	31.7	112	0.13	43	0.051
Wilkinson	100	18,635	8,601	16.6	41	0.09	13	0.029

Note: Mass estimates are based on whole county. Concentration estimates are average event runoff concentration from agricultural lands.

In July and August 1996, EPA conducted biological assessments on Georgia watersheds that had sufficient agricultural loading to potentially impair designated stream use to determine which of those waters should be added to Georgia's Section 303(d) list of streams with water-quality-limited segments. Those waters identified by EPA as potentially impaired by agricultural nonpoint source loading and added to the 303(d) list in December 1996 are shown in Table 4-8.

Table 4-8. Waters Identified as Potentially Impacted by Agricultural Nonpoint Source Loading and Added to the Georgia 303(d) List

Waterbody	County	Pollutant(s) of Concern
Little River	Morgan and Putnam	Habitat
Sugar Creek	Morgan and Putnam	Nutrients
Hard Labor Creek	Morgan and Walton	Habitat
Lower Middle Oconee River	Barrow, Clarke, and Jackson	Not Identified
Middle Mulberry River	Barrow and Jackson	Habitat
Upper Mulberry River	Hall, Barrow, and Jackson	Habitat/Sediment
Walnut Creek	Hall and Jackson	Habitat
North Oconee River	Hall and Jackson	Habitat

Animal waste

In addition to contributing to nutrient loads, animal waste may contribute high loads of oxygen- demanding chemicals and bacterial and microbial pathogens. The waste may reach surface waters through direct runoff as solids or in their soluble form. Soluble forms may reach ground water through runoff, seepage, or percolation and reach surface water as return flow. As the organic materials decompose, they place an oxygen demand on the receiving waters which may adversely affect fisheries, and cause other problems with taste, odor, and color. When waters are contaminated by waste from mammals the possible presence of pathogens that affect human health, including fecal bacteria, is of particular concern. In addition to being a source of bacteria, cattle waste might be an important source of the infectious oocysts of the protozoan parasite *Cryptosporidium parvum*.

Pesticides

Pesticides applied in agricultural production can be insoluble or soluble and include herbicides, insecticides, miticides, and fungicides. They are primary transported directly through surface runoff, either in dissolved form or attached to sediment particles. Some pesticides can cause acute and chronic toxicity problems in the water or throughout the entire food chain. Others are suspected human carcinogens, although the use of such pesticides has generally been discouraged in recent years.

The major agricultural pesticides/herbicides used within the basin include 2,4-D, Prowl, Blazer/Basagran, Trifluralin/Treflan/Trilin, AAtrex/Atrizine, Gramoxone, Classic, Lexone/Sencor, and Lasso (alachlor) (compiled from the Georgia Herbicide Use Servey Summary [Monks and Brown, 1991]). Since 1990, the use of alachlor in Georgia has decreased dramatically since peanut wholesalers no longer buy peanuts treated with alachlor.

Nonherbicide pesticide use is difficult to estimate. According to Stell et al. (1995), pesticides other than herbicides are currently used only when necessary to control some type of infestation (nematodes, fungi, insects). Other common nonherbicide pesticides include chlorothalonil, aldicarb, chlorpyrifos, methomyl, thiodicarb, carbaryl, acephate, fonofos, methyl parathion, terbufos, disulfoton, phorate, triphenyltin hydroxide (TPTH), and synthetic pyrethroids/pyrethrins. Application periods of the principal agricultural pesticides span the calendar year in the basin. However, agricultural pesticides are applied most intensively and on a broader range of crop types from March 1 to September 30 in any given year.

It should be noted that past uses of persistent agricultural pesticides that are now banned might continue to affect water quality within the basin, particularly through residual concentrations present in bottom sediments. A survey of pesticide concentration data by Stell et al. (1995) found that two groups of compounds had concentrations at or above minimum reporting levels in 56 percent of the water and sediment analyses. The first group included DDT and metabolites, and the second group included chlordane and related compounds (heptachlor, heptachlor epoxide)—while dieldrin was also frequently detected. All these pesticides are now banned by USEPA for use in the United States, but they might persist in the environment for long periods of time.

Nonpoint Sources from Urban, Industrial and Residential Lands

Water quality in urban waterbodies is affected by both point source discharges and diverse land use activities in the drainage basin (i.e., nonpoint sources). One of the most important sources of environmental stressors in the Oconee basin is diffuse runoff from urban, industrial, and residential land uses (jointly referred to as "urban runoff"). Nonpoint source contamination can impair streams that drain extensive commercial and industrial areas due to inputs of storm water runoff, unauthorized discharges, and accidental spills. Wet weather urban runoff can carry high concentrations of many of the same pollutants found in point source discharges, such as oxygen-demanding waste, suspended solids, synthetic organic chemicals, oil and grease, nutrients, lead and other metals, and bacteria. The major difference is that urban runoff occurs only intermittently, in response to precipitation events.

The characteristics of nonpoint urban sources of pollution are generally similar to those of NPDES permitted storm water discharges (Section 4.1.1.3). Separate storm water systems, however, are typically found in developed areas with high imperviousness and, frequently, sanitary sewer systems. Nonpoint urban sources of pollution include drainage from areas with impervious surfaces, but also includes less highly developed areas with greater amounts of pervious surfaces such as lawn, gardens, and septic tanks, all of which may be sources of nutrient loading.

There is little site-specific data available to quantify loading in nonpoint urban runoff in the Oconee River basin, although estimates of loading rates by land use types have been widely applied in other areas. Peters and Kandell (1997) present a water quality index for streams in the Atlanta region, based primarily on nutrients and nutrient-related parameters. Data for metals, organics, biological conditions, and suspended sediment were generally unavailable. They report that the annual average index of water quality conditions generally improved at most long-term monitoring sites between 1986 and 1995. However, conditions markedly worsened between 1994 and 1995 at several sites where major development was ongoing.

Pesticides and Herbicides from Urban and Residential Lands

Urban and suburban land uses are also a potential source of pesticides and herbicides through application to lawns and turf, roadsides, and gardens and beds. Stell et al. (1995) provide a summary of usage in the Atlanta Metropolitan Statistical Area (MSA). The herbicides most commonly used by the lawn-care industry are combinations of dicamba, 2,4D, mecoprop (MCPP), 2,4DP, and MCPA, or other phenoxy-acid herbicides. Most commercially available weed control products contain one or more of the following compounds: glyphosphate, methyl sulfometuron, benefin (benfluralin), bensulide, acifluorfen, 2,4-D, 2,4-DP, and dicamba. Atrazine was also available for purchase until it was restricted by the state of Georgia on January 1, 1993. The main herbicides used by local and state governments are glyphosphate, methyl sulfometuron, MSMA, 2,4D, 2,4DP, dicamba, and chlorsulforon. Herbicides are used for preemergent control of crabgrass in February and October and for postemergent control in the summer. Data from the *1991 Georgia Pest Control Handbook* (Delaplane, 1991) and a survey of CES and SCS personnel conducted by Stell et al. indicate that several insecticides could be considered ubiquitous in urban/suburban use, including chlorpyrifos, diazinon, malathion, acephate, carbaryl, lindane, and dimethoate. Chlorothalonil, a fungicide, is also widely used in urban and suburban areas.

Other Urban/Residential Sources

Urban and residential storm water also potentially includes pollutant loads from a number of other terrestrial sources:

Septic Systems. Poorly sited and improperly operating septic systems can contribute to the discharge of pathogens and oxygen-demanding pollutants to receiving streams. This problem is addressed through septic system inspections by the appropriate County Health Department, extension of sanitary sewer service, and local regulations governing minimum lot sizes and required pump-out schedules for septic systems.

Leaking Underground Storage Tanks. The identification and remediation of leaking underground storage tanks is the responsibility of the EPD Land Protection Branch. Petroleum hydrocarbons and lead are typically the pollutants associated with such tanks.

Nonpoint Sources from Forestry

Forest land is the dominant cover in the Oconee Basin, accounting for 69 percent of land cover in 1991. Undisturbed forest land generally presents very low stressor loading compared to other land uses, while conversion of forest to urban/residential land uses is often associated with water quality degradation. From 1982 through 1989, the area classified as commercial forest land within the Oconee basin decreased by approximately 1,053 acres.

Silvicultural operations may serve as sources of stressors, primarily contributing excess sediment loads to streams when best management practices (BMPs) are not followed. From a water quality standpoint, woods roads pose the greatest potential threat of any of the typical forest practices. It has been documented that 90 percent of the sediment that entered streams from a forestry operation was directly related to either poorly located or poorly constructed roads. The potential impact on water quality from erosion and sedimentation is increased if BMPs are not adhered to.

As of the 1996-1997 *Water Quality in Georgia* report (EPD, 1998), no streams in the basin were identified as impacted due to commercial forestry activities.

Statewide BMP Implementation Survey

In 1992 the Georgia Forestry Commission (GFC) conducted a statewide BMP implementation survey to determine to what extent forestry BMPs were being implemented. Within the entire Oconee basin, the GFC evaluated 34 sites involving 3,718 acres of land. Twenty three sites totaling 2,319 acres were located on private lands, 8 sites totaling 1,159 acres were located on forest industry land, and 3 sites totaling 200 acres were located on public land. Overall compliance with BMPs was 93 percent. By ownership, compliance was 90 percent on private lands, 97 percent on forest industry lands, and 100 percent on public lands. Compliance for roads, timber harvesting, site preparation, and regeneration is discussed in the following paragraphs.

The majority of main haul roads evaluated on 34 sites were in compliance with BMPs. Problems were noted where roads did not follow the contour, and where water diversions to slow surface water flow and divert the flow out of the road were needed but not installed. Main haul roads crossed streams on almost half of the sites, and culverts were sized correctly for the majority of the watershed. Almost a third of the crossings were located on grades that were too steep, and were not stabilized correctly. By ownership, road compliance for private lands, forest industry, and public lands was 94 percent, 97 percent and 100 percent, respectively.

The majority of the harvested acres evaluated on 32 sites were in compliance with BMPs. Problems were noted where water bars were not installed in skid trails on sites with sloping terrain. Only 47 percent of the log decks were stabilized. Equipment was improperly serviced on 9 percent of the sites. Harvesting within the recommended Streamside Management Zones (SMZs) occurred on only 16 sites and resulted in 25 percent of the zones being rutted or damaged and excess logging debris left in the streams on 63 percent of the sites. Log decks were properly located outside the recommended zone. Temporary stream crossings occurred on a few sites and were properly removed after the harvest on almost half of the sites. By ownership, harvesting compliance for private, forest industry, and public lands was 90 percent, 97 percent, and 100 percent, respectively.

The majority of the 351 site-prepared acres which were evaluated on five sites were in compliance with BMPs. The main problem with noncompliance involved heavy mechanical clearing where too much topsoil was pushed into windrows. There was excellent compliance with other BMPs. By ownership, site preparation compliance for private lands and forest industry was 99 percent and 97 percent, respectively.

Two tracts involving 115 acres were evaluated for regeneration, and all 115 were in compliance with BMPs. The tracts occurred on private lands.

Pesticides and Herbicides from Silviculture

Silviculture is also a potential source of pesticides/herbicides. According to Stell et al. (1995), pesticides are mainly applied during site preparation after clear-cutting and during the first few years of new forest growth. Site preparation occurs on a 25-year cycle on most pine plantation land, so the area of commercial forest with pesticide application in a given year is relatively small. The herbicides glyphosate (Accord), sulfometuron methyl (Oust), hexazinone (Velpar), imazapyr (Arsenal), and metsulfuron methyl (Escort) account for 95 percent of the herbicides used for site preparation to control grasses, weeds, and broadleaves in pine stands. Dicamba, 2,4-D, 2,4,-DP (Banvel), triclopyr (Garlon), and picloram (Tordon) are minor-use chemicals used to control hard to kill hardwoods and kudzu. The use of triclopyr and picloram has decreased since the early 1970s.

Most herbicides are not mobile in the soil and are targeted to plants, not animals. Applications made following the label instructions and in conjunction with BMPs should pose little threat to water quality.

Chemical control of insects and diseases is not widely practiced except in forest tree nurseries, very minor land use. Insects in pine stands are controlled by chlorpyrifos, diazinon, malathion, acephate, carbaryl, lindane, and dimethoate. Diseases are controlled using chlorothalonil, dichloropropene, and mancozeb. There is one commercial forest tree nursery in Laurens County and one seed orchard in Baldwin County.

Atmospheric Deposition

Atmospheric deposition can be a significant source of nitrogen and acidity in watersheds. Nutrients from atmospheric deposition, primarily nitrogen, are distributed throughout the entire basin in precipitation. The primary source of nitrogen in atmospheric deposition is nitrogen oxide emissions from combustion of fossil fuels. The rate of atmospheric deposition is a function of topography, nutrient sources, and spatial and temporal variations in climatic conditions.

Atmospheric deposition can also be a source of certain mobile toxic pollutants, including mercury, PCBs, and other organic chemicals.

4.1.3 Flow and Temperature Modification

Many species of aquatic life are adapted to specific flow and temperature regimes. In addition, both flow and temperature affect the dissolved oxygen balance in water, and changes in flow regime can have important impacts on physical habitat. Thus, flow and temperature modifications can be important environmental stressors. They also interact with one another to affect the oxygen balance: flow energy helps control reaeration rate, while water temperature controls the solubility of dissolved oxygen. Higher water temperatures reduce oxygen solubility and thus tend to reduce dissolved oxygen concentrations. Further, increased water temperature increases the rate of metabolic activity in natural waters, which in turn can increase oxygen consumption by aquatic species.

Natural flows in the Oconee have been altered by the construction of major and minor dams.

4.1.4 Physical Habitat Alteration

Many forms of aquatic life are sensitive to physical habitat disturbances. Probably the major disturbing factor is erosion and loading of excess sediment, which changes the nature of the stream substrate. Thus, any land use practices that cause excess sediment input can have significant impacts.

Physical habitat disturbance is also evident in many urban streams. Increased impervious cover in urban areas can result in high flow peaks, which increase bank erosion. In addition, construction and other land-disturbing activities in these areas often provide an excess sediment load, resulting in a smothering of the natural substrate and physical form of streams with banks of sand and silt.

4.2 Summary of Stressors Affecting Water Quality

Section 4.1 described the major sources of loads of pollutants (and other types of stressors) to the Oconee basin. What happens in a river is often the result of the combined impact of many different types of loading, including point and nonpoint sources. For instance, excess concentrations of nutrients may result from the combined loads of wastewater treatment plant discharges, runoff from agriculture, runoff from residential lots, and other sources. Accordingly, Section 4.2 brings together the information contained in Section 4.1 to focus on individual stressor types, as derived from all sources.

4.2.1 Nutrients

All plants require certain nutrients for growth, including the algae and rooted plants found in lakes, rivers, and streams. Nutrients required in the greatest amounts include nitrogen and phosphorus. Some loading of these nutrients is needed to support normal growth of aquatic plants, an important part of the food chain. Too much loading of nutrients can, however, result in an overabundance of algal growth with a variety of undesirable impacts. The condition of excessive nutrient-induced plant production is known as eutrophication, and waters affected by this condition are said to be eutrophic. Eutrophic waters often experience dense blooms of algae, which can lead to unaesthetic scums and odors and interfere with recreation. In addition, overnight respiration of living algae, and decay of dead algae and other plant material, can deplete oxygen from the water, stressing or killing fish. Eutrophication of lakes typically results in a shift in fish populations to less desirable, pollution-tolerant species. Finally, eutrophication may result in blooms of certain species of blue-green algae which have the capability of producing toxins.

For freshwater aquatic systems, the nutrient in the shortest supply relative to plant demands is usually phosphorus. Phosphorus is then said to be the "limiting nutrient" because the concentration of phosphorus limits potential plant growth. Control of nutrient loading to reduce eutrophication thus focuses on phosphorus control.

Point and nonpoint sources to the Oconee also discharge large quantities of nitrogen, but nitrogen is usually present in excess of amounts required to match the available phosphorus. Nitrogen (unlike phosphorus) is also readily available in the atmosphere and ground water, so it is not usually the target of management to control eutrophication in freshwater. The bulk of the nitrogen in fresh-water systems is found in three ionic forms--ammonium (NH_4^+), nitrite (NO_2^-), or nitrate (NO_3^-). Nitrite and nitrate are more readily taken up by most algae, but ammonia is of particular concern because it can be toxic to fish and other aquatic life. Accordingly, wastewater treatment plant upgrades have focused on reducing the toxic ammonia component of nitrogen discharges, with corresponding increase in the nitrate fraction.

Sources of Nutrient Loading

The major sources of nutrient loading in the Oconee basin are wastewater treatment facilities, urban runoff and storm water, and agricultural runoff. Concentrations found within rivers and lakes of the Oconee basin represent a combination of a variety of point and nonpoint source contributions.

Point source loads can be quantified from permit and effluent monitoring data, but nonpoint loads are difficult to quantify. Rough estimates of average nutrient loading rates from agriculture are available; however, nonpoint loads from urban/residential sources in the basin have not yet been quantified. The net load arising from all sources may, however, be examined from instream monitoring. Long-term trends in nutrients within the Oconee River basin can be obtained by examining results from EPD long-term trend monitoring stations.

Trends in instream total phosphorus concentrations at three sites in the Oconee River are shown in Figures 4-8 through 4-10, and are summarized in Table 4-9.

4.2.2 Oxygen Depletion

Oxygen is required to support aquatic life, and Georgia water quality standards specify minimum and daily average dissolved oxygen concentration standards for all waters. Problems with oxygen depletion in rivers and streams of the Oconee basin are associated with oxygen-demanding wastes from point and nonpoint sources. Historically,

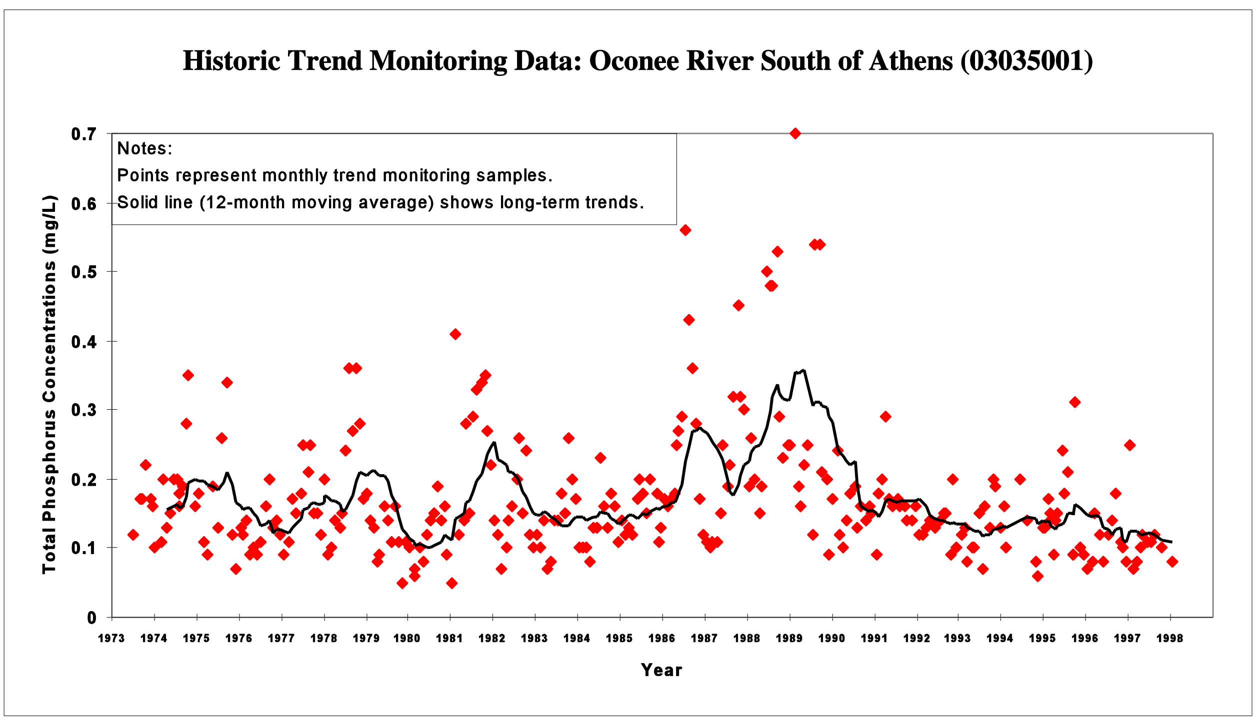

Figure 4-8. Total Phosphorus Concentrations, Oconee River South of Athens, 1973-1998

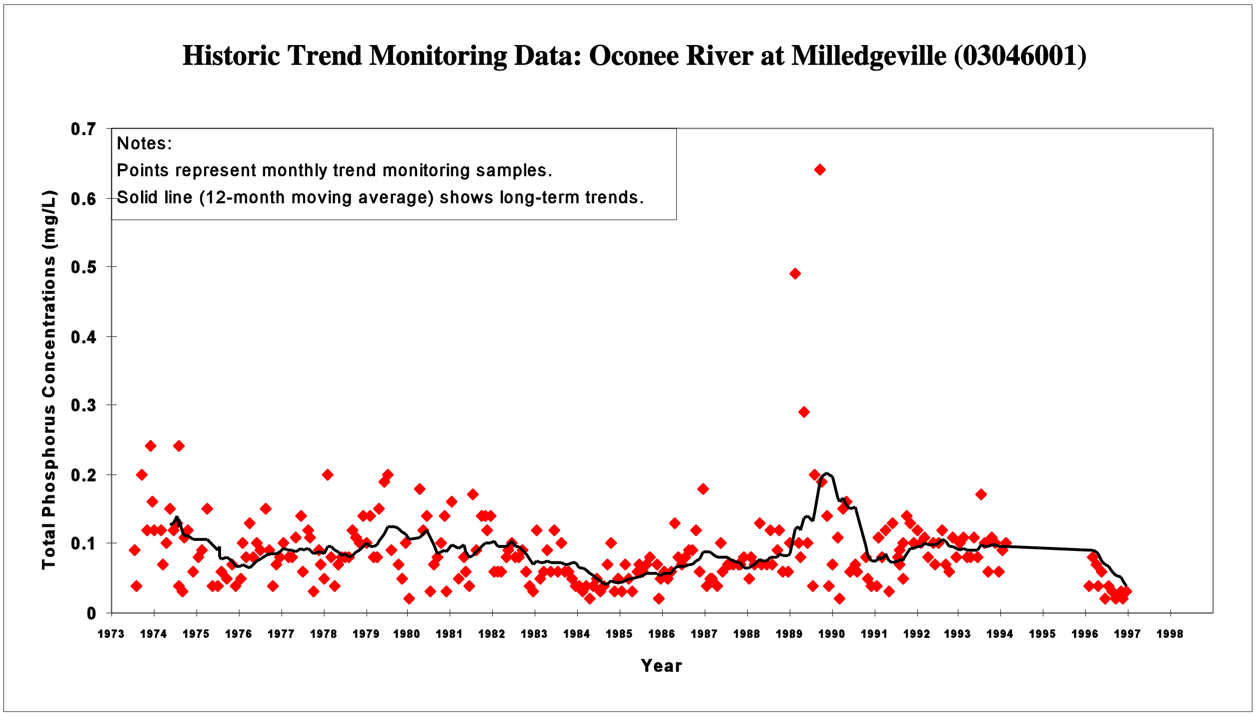

Figure 4-9. Total Phosphorus Concentrations, Oconee River near Milledgeville, 1973-1996

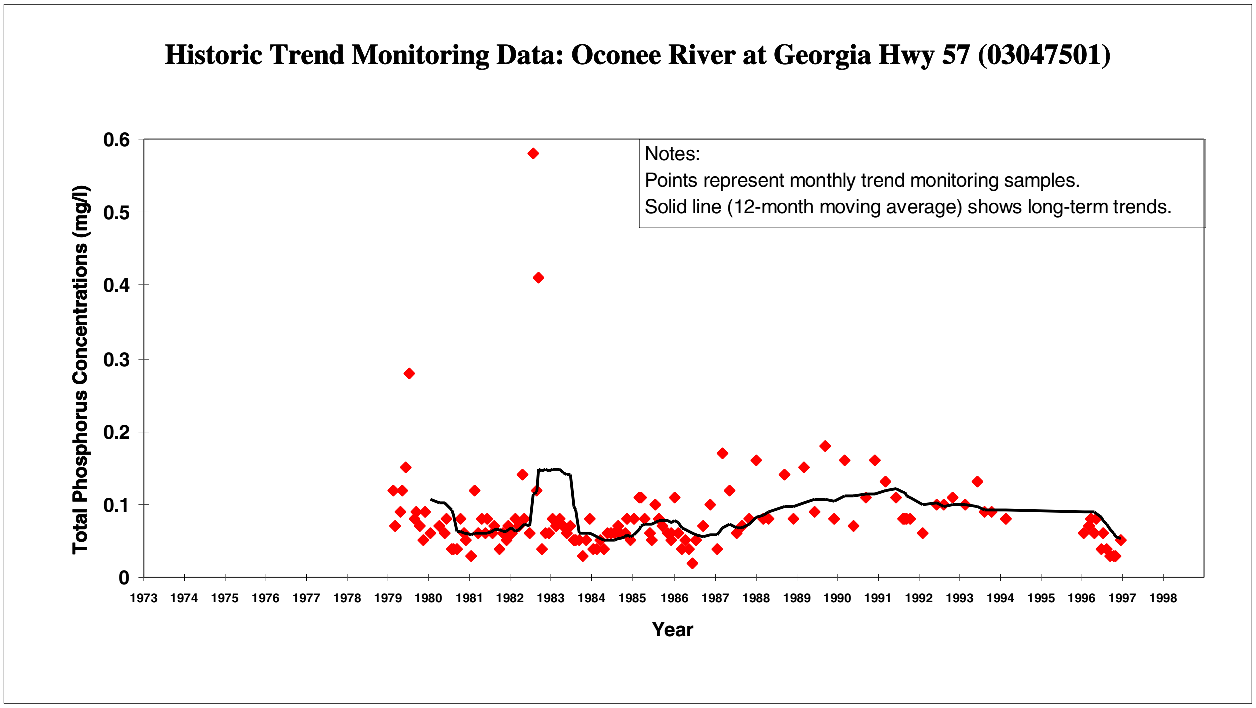

Figure 4-10. Total Phosphorus Concentrations, Oconee River at Georgia Highway 57, 1979-1996

Table 4-9. Summary of Phosphorus Concentration Data in Oconee River Mainstem

		Phosphorus Concentrations (mg/L)			
Station	Years	Average	Median	Minimum	Maximum
South of Athens	1973-1998	0.17	0.15	0.05	0.70
Near Milledgeville	1973-1996	0.09	0.08	0.02	0.64
Georgia Highway 57	1979-1996	0.08	0.07	0.02	0.58

the greatest threat to maintaining adequate oxygen levels to support aquatic life has come from the discharge of oxygen-demanding wastes from wastewater treatment plants. Treatment upgrades and more stringent permit limits have reduced this threat substantially.

Trends in instream dissolved oxygen concentrations at three sites in the Oconee River are shown in Figures 4-11 through 4-13, and are summarized in Table 4-10. All waters in the Oconee basin have a state water quality standard of 5.0 mg/L. As shown in Figures 4-11 through 4-13, this standard has seldom been violated at these three sites, and there has been a general upward trend in dissolved oxygen concentrations as point sources have been brought under tighter control.

4.2.3 Metals

Violations of water quality standards for metals (e.g., lead, copper, zinc) were the third most commonly listed causes of nonsupport of designated uses in the 1996-1997 water quality assessment of the Oconee basin, after fecal coliform and poor fish communities. In most cases, these metals are attributed to nonpoint urban runoff and

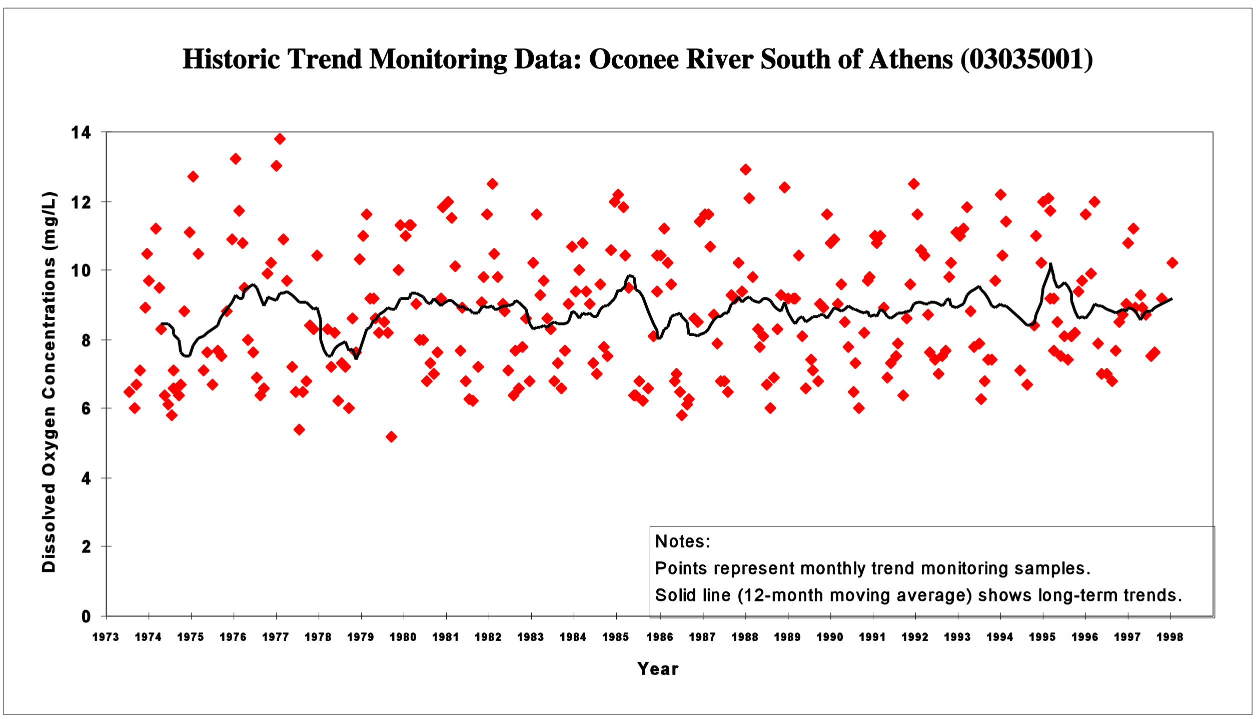

Figure 4-11. Dissolved Oxygen Concentrations, Oconee River South of Athens, 1973-1998

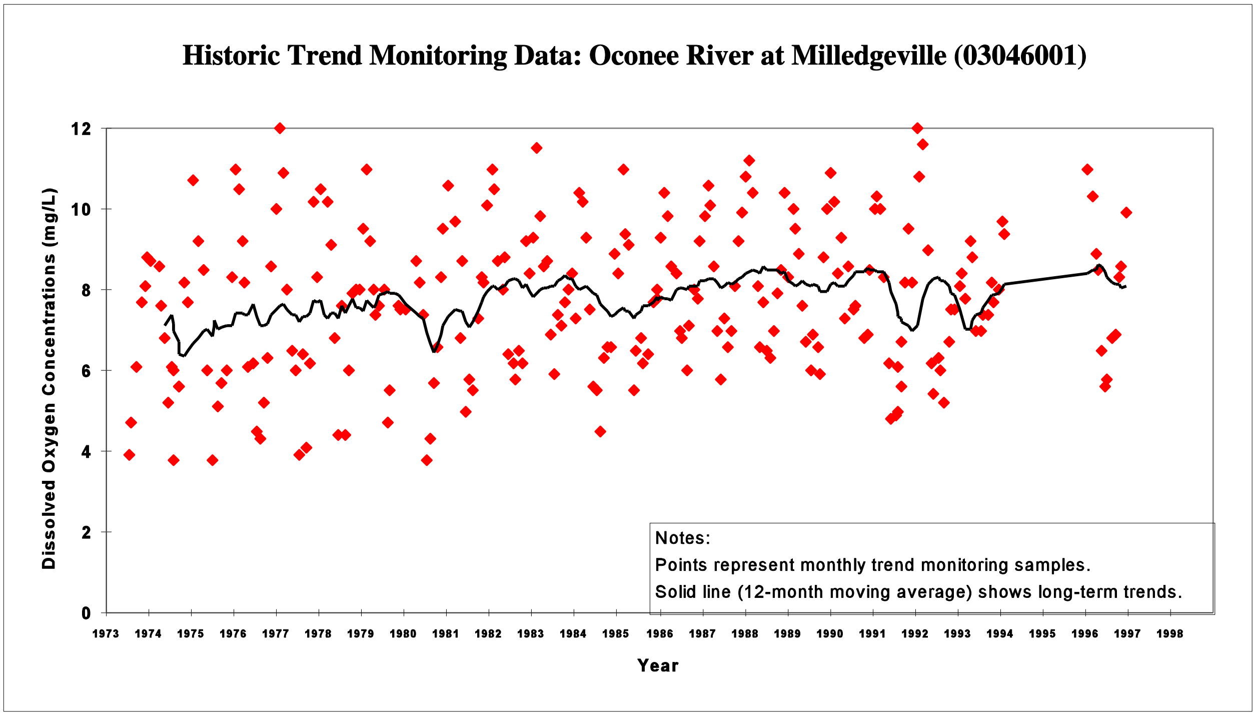

Figure 4-12. Dissolved Oxygen Concentrations, Oconee River near Milledgeville, 1973-1996

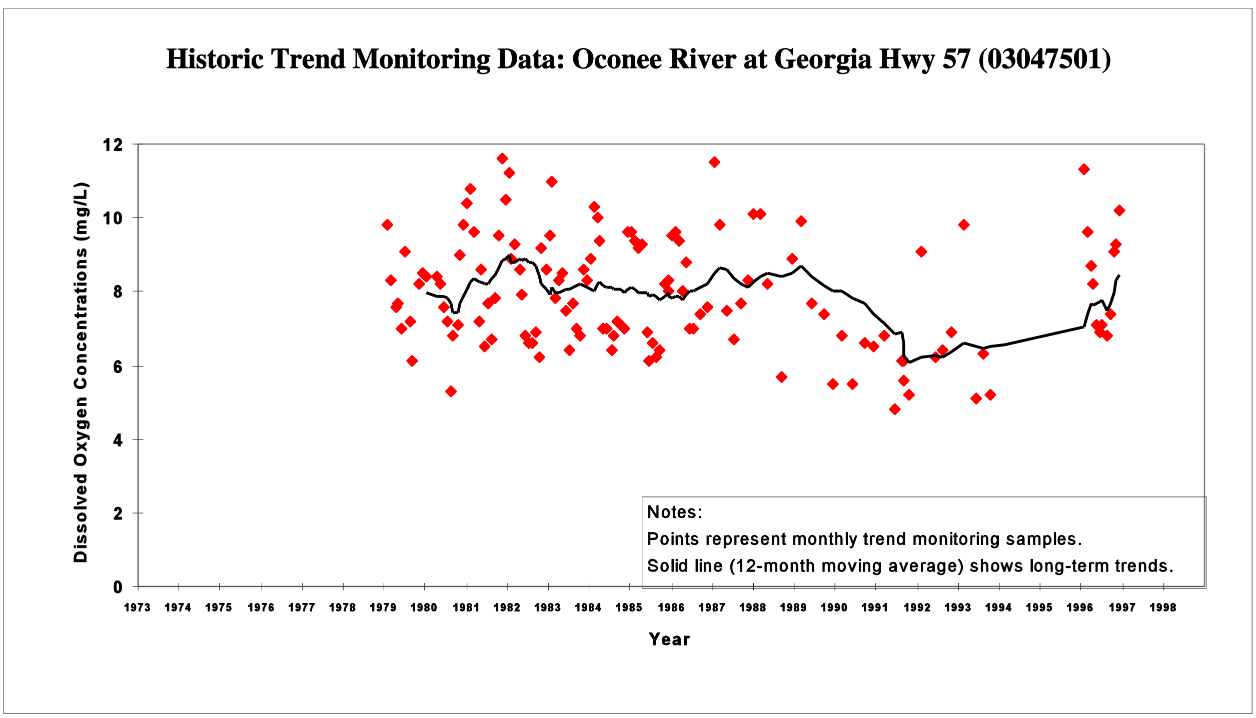

Figure 4-13. Dissolved Oxygen Concentrations, Oconee River at Georgia Highway 57, 1979-1996

Table 4-10. Summary of Dissolved Oxygen Concentration Data in Oconee River Mainstem

		Dissolved Oxygen Concentrations (mg/L)			
Station	**Years**	**Average**	**Median**	**Minimum**	**Maximum**
South of Athens	1973-1998	8.8	8.6	5.2	13.8
Near Milledgeville	1973-1996	7.8	7.8	3.8	12.0
Georgia Highway 57	1979-1996	8.0	7.7	4.8	11.6

storm water. Point sources also contribute metals loads; however, major point sources of metals in the Oconee basin (wastewater treatment plants and certain industrial discharges) have been brought into compliance with permit limits, leaving the more-difficult-to-control nonpoint sources as the primary cause of impairment.

It should be noted that sample data on metals in many streams is rather sparse, and there are concerns regarding the quality of some of the older data. Although urban runoff appears to be the primary source of loading of these stressors, loading rates have not been quantified and will require additional study.

4.2.4 Fecal Coliform Bacteria

Violations of the standard for fecal coliform bacteria were the most commonly listed cause of nonsupport of designated uses in the 1996-1997 water quality assessment. Fecal coliform bacteria are monitored as an indicator of fecal contamination and the possible presence of human bacterial and protozoan pathogens in water. Fecal coliform bacteria may arise from many of the different point and nonpoint sources discussed in Section 4.1. Human waste is of greatest concern as a potential source of bacteria and other pathogens. One primary function of wastewater treatment plants is to reduce this risk through disinfection. Observed violations of the fecal coliform standard below several wastewater treatment plants on the Oconee River have generally been rapidly corrected in recent years.

Trends in instream fecal coliform concentrations at three sites in the Oconee River are shown in Figures 4-14 through 4-16, and are summarized in Table 4-11. These figures show that fecal coliform concentrations have been dropping at all three sites as point sources have been brought under tighter control.

As point sources have been brought under control, nonpoint sources have become increasingly important as potential sources of fecal coliform bacteria. Nonpoint sources may include

- Agricultural nonpoint sources, including concentrated animal operations and spreading and/or disposal of animal wastes.
- Runoff from urban areas transporting surface dirt and litter, which may include both human and animal fecal matter, as well as a fecal component derived from sanitary sewer overflows. Urban nonpoint sources of pollution appear to present the greatest problem for fecal coliform loading in the upper portion of the Oconee basin (HUC 03070101).
- Urban and rural input from failed or ponding septic systems.

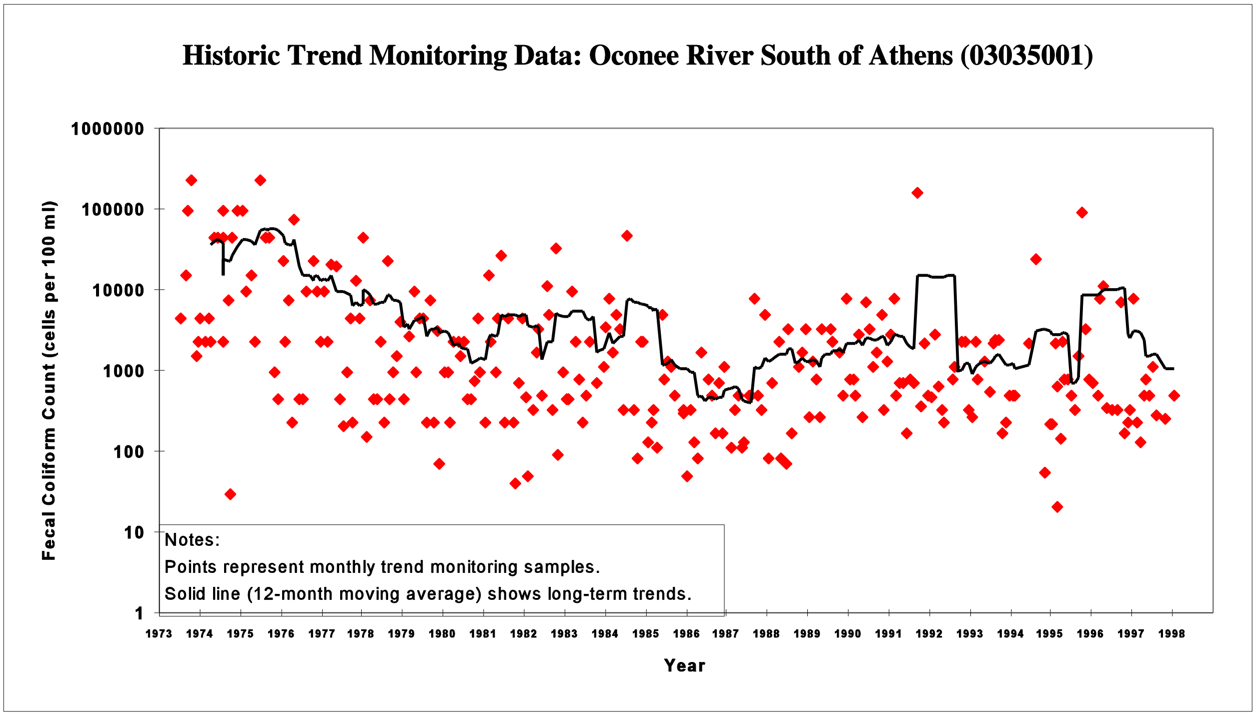

Figure 4-14. Fecal Coliform Counts, Oconee River South of Athens, 1973-1998

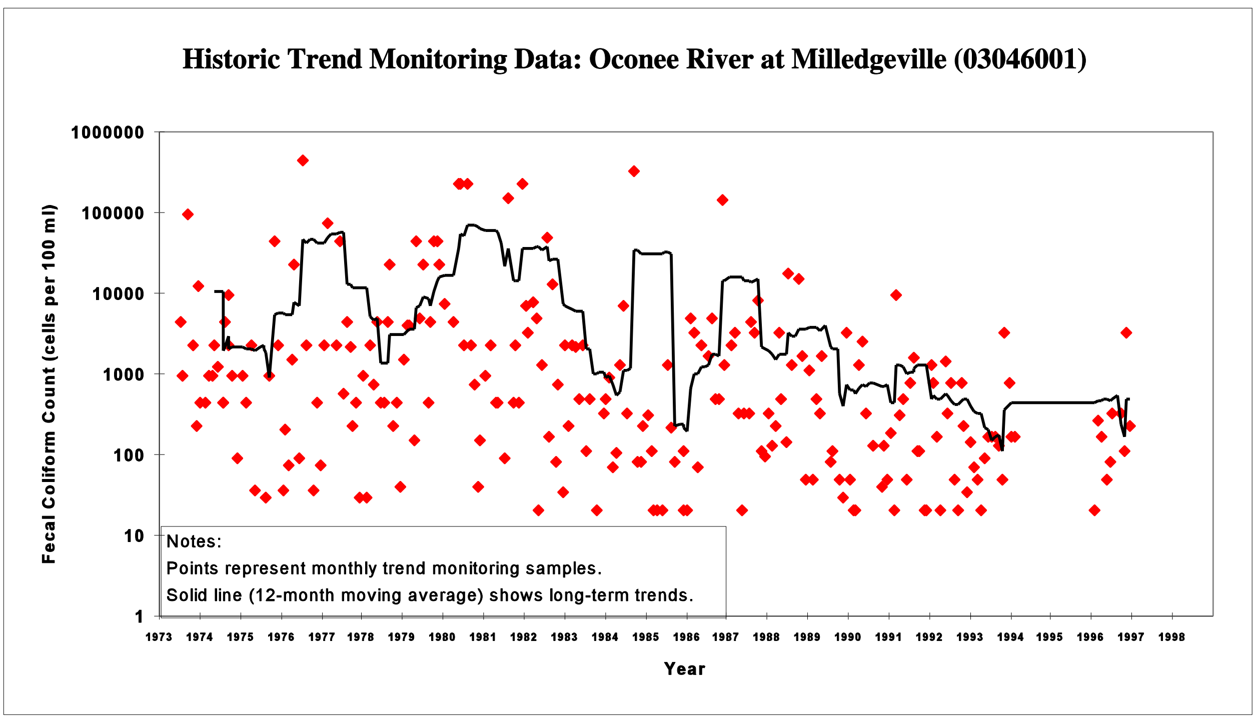

Figure 4-15. Fecal Coliform Counts, Oconee River near Milledgeville, 1973-1996

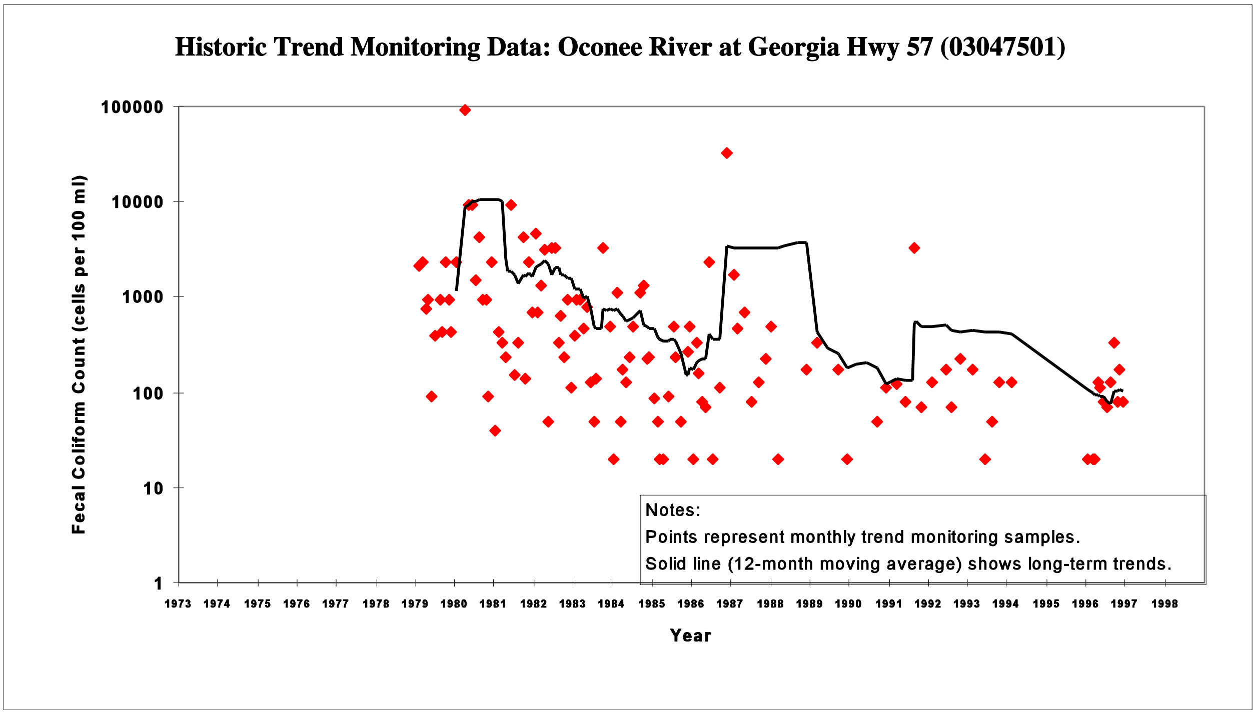

Figure 4-16. Fecal Coliform Counts, Oconee River at Georgia Highway 57, 1979-1996

Table 4-11. Summary of Fecal Coliform Concentration Data in Oconee River Mainstem

		Fecal Coliform Count (cells per 100 ml)				
Station	Years	Average	Median	Geometric Mean	Minimum	Maximum
South of Athens	1973-1998	8,150	930	1,280	20	230,000
Near Milledgeville	1973-1996	11,890	430	610	20	430,000
Georgia Highway 57	1979-1996	1,900	230	300	20	93,000

4.2.5 Synthetic Organic Chemicals

Synthetic organic chemicals (SOCs) include pesticides, herbicides, and other man-made toxic chemicals. SOCs may be discharged to waterbodies in a variety of ways, including

- Industrial point source discharges.
- Wastewater treatment plant point source discharges, which often include industrial effluent as well as SOCs from household disposal of products such as cleaning agents and insecticides.
- Nonpoint runoff from agricultural and silvicultural land with pesticide and herbicide applications.
- Nonpoint runoff from urban areas, which may load a variety of SOCs such as horticultural chemicals and termiticides.
- Illegal disposal and dumping of wastes.

To date, SOCs have not been detected in the surface waters of the Oconee River basin in problem concentrations. It should be noted, however, that most monitoring has been targeted to waters located below point sources where potential problems were suspected. Agricultural sources were potentially important in the past, particularly from cotton production in the Coastal Plain, but the risk has apparently greatly declined with a switch to less persistent pesticides. Recent research by USGS (Hippe et al., 1994; Stell et al., 1995) suggests pesticide/herbicide loading in urban runoff and storm water may be of greater concern than agricultural loading, particularly in streams of the metropolitan Atlanta area.

4.2.6 Stressors from Flow and Temperature Modification

Stress from flow modification is primarily associated with peaking hydropower operation of dams on the Oconee River, as well as stormflow in smaller streams associated with development and increased impervious area.

4.2.7 Sediment

Erosion and discharge of sediment can have a number of adverse impacts on water quality. First, sediment can carry attached nutrients, pesticides, and metals into streams. Second, sediment is itself a stressor. Excess sediment loads can alter habitat, destroy spawning substrate, and choke aquatic life, while high turbidity also impairs recreational and drinking water uses. Sediment loading is of concern throughout the basin, but is of greatest concern in the developing metropolitan areas and major transportation corridors. The rural areas are of lesser concern with the exception of rural unpaved road systems and areas where cultivated cropland exceeds 20 percent of the total land cover.

4.2.8 Habitat Degradation and Loss

In many parts of the Oconee basin, support for native aquatic life is threatened by degradation of aquatic habitat. Habitat degradation is closely tied to sediment loading, and excess sediment is the main threat to habitat in rural areas with extensive land-disturbing activities, as well as in urban areas where increased flow peaks and construction can choke and alter stream bottom substrates. A second important type of habitat degradation in the Oconee basin is loss of riparian tree cover, which can lead to increased water temperatures.

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